I. **Rejection of Claims 39-41, 46, 48, and 50-52 Under 35 U.S.C. § 103(a)**

Claims 39-41, 46, 48, and 50-52 are rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Iimuro et al., Japanese Patent Application 1-239933 and Hawthorne et al., U.S. Patent No. 5,785,875. Applicants traverse.

Iimuro neither teaches nor suggests an apparatus for cleaning semiconductors that forms a film or layer of liquid solvent on a surface of a wafer (claims 39-41, 46, 48, 50-52) or that forms a film or layer of liquid solvent that comprises a transport medium that carries a reactant gas through the film to a wafer surface[1] (claims 39-41, 46, 48, 50-52) or that includes a temperature controller that maintains at least one wafer at a temperature lower than about the dew point of the solvent or to cool the surface of the wafer (at or below ambient temperature) (claims 39-41, 46, and 48).

On page 4 of the present Office action (dated October 18, 2000) the Examiner acknowledges that Iimuro does not recite an apparatus that forms a film or layer of liquid solvent on a wafer surface. The Examiner contends, however, that because Iimuro teaches vaporizing water and heating a wafer, the step of forming a film or layer of liquid solvent on a wafer would be known to those skilled in the art. Applicants disagree.

Iimuro teaches an ashing gas method. Specifically, Iimuro teaches mixing ozone with water vapor in a gas/liquid mixing vessel 12 that is separated from the wafer 3 (Fig. 1, Constitution). The ozone/water vapor mixture is then passed through a supply tube 9a to flow toward a surface of the wafer 3. Iimuro further teaches heating a wafer to remove the film deposited on the wafer surface (Constitution). There is no teaching or suggestion in Iimuro that the wafer be maintained at or below the dew point of water (the water vapor of Iimuro is the liquid the Examiner contends is equivalent to the present invention's "liquid solvent"). Additionally, Iimuro teaches the "ashing method" that the current invention was designed to avoid due to undesirable high-energy gas formation when ozone is mixed with water vapor (see page 2, lines 10-14 and Iimuro Constitution, e.g., "the decomposition of the ozone is accelerated because the mixed water vapor reduces the amount of the ozone, thereby producing oxygen

[1] The liquid solvent of the present invention acts only as a transport medium to put a reactant gas in physical contact with the wafer surface; the liquid solvent does not react with the wafer surface. (See, for example, page 4, lines 5-18 of the present application).

radicals and hence speeding up the ashing treatment." Furthermore, there is no indication in Iimuro that a film of water is formed on the wafer surface. To the contrary, Iimuro teaches heating the wafer to remove films from the wafer surface (Constitution).

Moreover, applicants' disclosure cannot be used as the source for the motivation or incentive to modify the Iimuro method to teach controlling the wafer temperature so as to form a thin layer of a liquid solvent on a wafer surface to transport a reactant gas therethrough to react with the wafer surface as recited by the claims of the present invention.

Hawthorne does not make up for the deficiencies of Iimuro. The Examiner contends that Hawthorne teaches a wafer cleaning apparatus wherein a thin film of a liquid is formed on a wafer surface (Office action, page 5). However, the Examiner does not contend that such liquid vapor film acts as a transport medium for a reactive gas (because Hawthorne clearly does not). Nor does the Examiner contend that Hawthorne teaches an apparatus including a reactant gas that is transported through such a thin film of liquid solvent (because Hawthorne does not). Additionally, the Examiner does not contend that Hawthorne teaches forming a film of a liquid solvent equivalent to the liquid solvent of the present invention. Hawthorne does not teach or suggest forming a film of a liquid solvent that will not react with the wafer surface, as recited in the present claims. To the contrary, Hawthorne teaches providing a solvent that will react with the wafer surface (see e.g., col. 2, line 55 through col. 3, line 19).

More particularly, Hawthorne teaches vaporizing a reactant solvent and using such vapor solvent to react with and remove photoresist. Nothing in Hawthorne teaches or suggests any of the above-mentioned features recited in the apparatus claims of the present invention. Furthermore, Hawthorne teaches that the thin layer of the reactant solvent "typically" formed on the wafer is a result of the pressure flow of the vapor from the Hawthorne boiler 22 (see col. 5, lines 29-36). That is, there is no indication that the Hawthorne wafer apparatus includes a temperature control mechanism - there is absolutely no mention in Hawthorne of such a device.

For all of the foregoing reasons, claims 39-41, 46, 48, and 50-52 are clearly patentable over the art of record.

II. **Rejection of Claims 47, 53, and 54 Under 35 U.S.C. § 103(a)**

Claims 47, 53, and 54 are rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Iimuro and Hawthorne. Applicants traverse.

Because claims 47, 53, and 54 are allowable over the art of record for the same reasons discussed above in relation to claims 39-41, 46, 48, and 50-52, there is no need to discuss the unique and non-obvious features of the reactant gas/non-reactant solvent ratios recited in the subject claims, nor the recited thicknesses of the non-reactant solvent films.

III. **Rejection of Claims 42, 44, 55, and 56 Under 35 U.S.C. § 103(a)**

Claims 42, 44, 55, and 56 are rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Iimuro and Hawthorne and further in view of Ofuku et al., Japanese Application No. 8-250483. Applicants traverse.

As the Examiner states, Iimuro and Hawthorne clearly do not show all the limitations of claims 42, 44, 55, and 56 as they do not apply a liquid solvent to a wafer surface directly in liquid form. To make up for the deficiencies in Iimuro and Hawthorne, the Examiner cites Ofuku. The Examiner states that Ofuku, by "supplying a flow of fluid 7 to cover the surface of the semiconductor wafer 3 by means of a nozzle applicator 6" applies a liquid directly onto a wafer (Office action, page 10). This contention is clearly incorrect. Ofuku does not teach applying any liquid whatsoever. Rather, Ofuku teaches applying a "fluid 7 composed of a mixed gas of oxygen and ozone, etc. . . ." (Ofuku Constitution). That is, the fluid Ofuku teaches is a gas, not a liquid as recited in claims 42, 44, 55, and 56.

For the reasons discussed above under Sections I and II and the reasons set forth immediately above, claims 42, 44, 55, and 56 are allowable over the art of record.

IV. **Rejection of Claims 43 and 45 Under 35 U.S.C. § 103(a)**

Claims 43 and 45 are rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Iimuro and Hawthorne and further in view of Ofuku. Applicants traverse.

Because claims 43 and 45 are allowable over the art of record for the same reasons discussed above in Sections I-III, there is no need to discuss the other unique and non-

obvious features recited in claims 43 and 45. Clearly, these claims are allowable over the art of record.

V. Rejection of Claims 49 Under 35 U.S.C. § 103(a)

Claims 43 and 45 are rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Iimuro and Hawthorne and further in view of Koizumi et al., Japanese Application No. 7-171519. Applicants traverse.

Because claims 43 and 45 are allowable over the art of record for the same reasons discussed above in Sections I-III, there is no need to discuss the other unique and non-obvious features recited in claims 43 and 45. Clearly, these claims are allowable over the art of record.

VI. Conclusion

For the foregoing reasons, the claims of the present application are in condition for allowance and early notification to that effect is respectfully requested.

Respectfully submitted,

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Marked-up Version of the Title, Amended Paragraph and Amended Claims

In the Title:

SEMICONDUCTOR FABRICATION [METHODS AND] APPARATUS

In the Specification:

In order to ensure that only desired portions of the thin film are removed, a photolithography process is used by which a pattern is transferred to the surface of the thin film. The pattern serves to identify the areas of the thin film that are to be selectively removed. The pattern is typically formed with a photoresist material, typically a light-sensitive material that is spun onto the in-process integrated-circuit wafer also in the form of a thin film. The thin film of photoresist is then exposed to a high intensity light source that is projected through a photomask. The photomask defines a desired pattern. As the light source is projected through the photomask, the desired pattern is defined on the photoresist thin film. The exposed or unexposed photoresist, depending upon the polarity of the photoresist material, is dissolved (i.e., is removed or stripped) with developers, leaving a pattern that allows etching to take place in the selected areas only.

In the Claims:

42. (Twice Amended) An apparatus for delivering ozone gas to the surface of a wafer comprising:

a wafer receiving chamber;

a wafer carrier positioned within the chamber;

at least one wafer positioned in the wafer carrier in a substantially vertical position within the wafer receiving chamber;

a liquid depositor adapted to produce a stream of liquid solvent and form a layer of the liquid solvent on at least one major surface of a wafer supported by the wafer carrier within the chamber, wherein the stream is produced in a direction substantially parallel to the at least one major surface of the wafer;

an ozone gas source coupled to the chamber so as to deliver ozone gas to the chamber and increase the concentration of ozone gas within the chamber;

the liquid solvent layer transporting ozone gas to the surface of the wafer to thereby expose the wafer surface to ozone.